WAKE CHARACTERISTICS STUDIES

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Ocean and Atmospheric Science, Incorporated

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13. ABSTRACT

The technical details of this contract and its extension are briefly summarized. Specifics are given in the technical reports listed.

Signal areas of investigation are:

Diffusion in the wake, signal processing of ocean surface waves, and analyses of oceanographic experiments.

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TR 73-173

Final Report II

Wake Characteristic Studies

by

C. E. Grosch and B. Harris
E. Y. T. Kuo, M. Bernstein and R. Gershman

Submitted under Contract No. N00014-72-C-0127

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Sponsored by
Advanced Research Projects Agency
ARPA Order No. 1910

ARPA Order Number:	1910
Program Code Number:	3E 20
Contract Number:	N00014-72-C-0127
Principal Investigator and Phone Number:	Dr. Chester E. Grosch 914-693-9001
Name of Contractor:	Ocean & Atmospheric Science, Inc.
Effective Date of Contract:	August 1, 1971
Contract Expiration Date:	15 February 1973
Amount of Contract:	$130,588.00
Scientific Officer:	Director, Fluid Dynamics Program Mathematical and Information Sciences Division Office of Naval Research Department of the Navy 800 North Quincy Street Arlington, Virginia 22217
Short Title of Work:	Wake Diffusion Modeling

This research was supported by the Advanced Research Projects Agency of the Department of Defense and was monitored by ONR under Contract No. N00014-72-C-0127.

This is the second part of the final report under Contract No. 00014-72-0127 for the Office of Naval Research, sponsored by Advanced Research Projects Agency (ARPA Order No. 1910, Program Code 3E20), by Ocean & Atmospheric Science, Inc. The work effort is summarized below and encompasses the results obtained under the entire contract. Details are covered in the attached list of technical reports which includes both those generated under the original contract and its extension.

The areas of investigation were:

1. Diffusion from the wake
2. Signal processing
3. Analysis of oceanographic experiments

The basic objective of task one was to study the diffusion of a passive scalar from the turbulent wake of a self-propelled body. A number of detailed calculations were carried out. The late stages of the diffusion were modeled by calculating the diffusion from a well-mixed and essentially non-turbulent wake under the influence of the background ocean turbulence. The validity of various diffusion models and related data on diffusion coefficients were examined. Based on the existing diffusion data, related turbulence data for the oceans, and basic turbulence theory, estimates were obtained of the ocean diffusion coefficients at intermediate depths, which are the region of interest.

Finally, the diffusion in the early wake was modeled with a point source. Using this model, equations were derived which permit the calculation of the concentration of the scalar through the stage of wake growth and subsequent collapse and deformation.

Task two was signal processing and was related to how the passage of a submerged object can alter the surface wave power spectra. The evaluation carried out under this contract is of a system and signal processor which examines the consequent alterations in the directional wave power spectrum and uses the maximum likelihood ratio to decide if such passage has occurred. Recommendations were made to examine the high wavenumber phenomena as it is here that the processing gain is greatest.

Task three, oceanographic experiment analysis, was combined of several subtasks. These included a critical review of available methods for measuring short surface gravity waves and capillary waves, a review of the state of knowledge of the thermal structure of the air-sea interface, and an analysis of the potential for using an acoustic techniques to probe the fine structure of the thermocline. The last item described a unique OAS system which exploited low angle reflectance to attain good performance with small arrays.

The extension encompassed:

1. A review of the thermal structure of the air-sea interface and concluded with recommendations as to experiments and theoretical analyses to fill the voids pertinent to the applications of interest here.
2. A proposed experimental design and analysis of that design for using a vertical array system to acoustically detect the fine structure of the thermocline. This analysis is, in part, a presentation to repudiate Dr. Lane's contention that the system is not feasible.
3. A presentation was given by Dr. Grosch at the Workshop on Submarine Wakes and Internal Wave Generation encompassing the diffusion of a passive scaler from a turbulent wake.

TABLE I

Technical Reports Prepared
Under Contract N00014-72-C-0127

OAS Report No.	Title and Author(s)
71-057	Equalization of the Thermistor Response B. Harris
71-062	Preliminary Evaluation of an Active Sonar System for Measuring the Fine Structure of the Thermocline. B. Harris
72-065	Some Comments on the Modeling of the Collapsing Wake. E. Y. T. Kuo and C. E. Grosch
72-070	Preliminary Analysis of Using a Vertical Array Sonar System to Measure the Fine Structure of the Thermocline. B. Harris and R. M. Chervin
72-073	Some Comments on the Modeling of the Turbulent Wake of a Self-Propelled Body in a Stratified Fluid. E. Y. T. Kuo and C. E. Grosch
72-083	Signal Processing of Ocean Surface Effects (Secret) B. Harris and R. Gershman
72-084	Survey and Comments on Methods for Measuring the Spectrum of Ocean Surface, Short Wavelength Gravity Waves. E. Y. T. Kuo
72-089	Bi-mode Hypothesis and Horizontal Oceanic Turbulent Diffusion I. Theoretical Predictions E. Y. T. Kuo
72-092	Turbulent Diffusion in a Stratified Fluid with Application to the Ocean. C. E. Grosch

Table I (continued)

OAS Report No.	Title and Author (s)
72-106	Final Report: Wake Characteristics Studies. C. E. Grosch, B. Harris, E. Y. T. Kuo and R. Gershman
73-137	Experimental Design Analysis Vertical Array System for Acoustic Detection of the Fine Structure of the Thermocline. E. Y. T. Kuo and Bernard Harris
73-140	Diffusion of a Passive Scaler from a Turbulent Wave. C. E. Grosch
73-148	The Thermal Structure of the Air-Sea Interface - A Review C. E. Grosch, E. Y. T. Kuo and M. Bernstein
73-151	Critique on "Layered Oceanic Microstructure - Its effect on Sound Propogation. C. E. Grosch

These reports were completed under the extension.